GOVERNMENT DIGITAL PAYMENTS AND THE SIZE OF THE INFORMAL ECONOMY IN IRAQ: AN ARDL TIME-SERIES ANALYSIS, 2010–2024

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Abstract. This study examines the relationship between government digital payments and the size of the informal economy in Iraq using quarterly time-series data covering the period 2010Q1–2024Q4. The empirical analysis employs the Autoregressive Distributed Lag (ARDL) approach to distinguish between short-run dynamics and the long-run equilibrium relationship among the informal economy, government digital payments, cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation. The Augmented Dickey–Fuller test is used to examine the stationarity properties of the variables, while the ARDL bounds-testing procedure is applied to test for cointegration. Short-run dynamics and the speed of adjustment toward long-run equilibrium are evaluated using the corresponding error-correction model.

The ARDL bounds test provides strong evidence of cointegration among the variables, with an F-statistic of 5.1852, exceeding the upper critical bound at the 1% significance level. The error-correction term is negative and highly statistically significant (ECT = −0.4915, $p < 0.001$), indicating that approximately 49.2% of a deviation from the long-run equilibrium is corrected within one quarter.

In the short run, changes in government digital payments are negatively and statistically significantly associated with changes in the size of the informal economy at the second and third quarterly lags. However, the estimated long-run coefficient of government digital payments is positive and statistically significant ($\beta = 0.1478$, $p = 0.0019$), indicating that the expected negative relationship between digital-payment expansion and informality does not persist in the estimated long-run relationship.

Among the additional explanatory variables, GDP growth exhibits a negative and statistically significant long-run coefficient ($\beta = -0.9877$, $p < 0.001$). By contrast, cash outside the banking system, financial inclusion, digital infrastructure, and inflation do not exhibit statistically significant long-run coefficients. Financial inclusion nevertheless shows a negative and statistically significant association with the informal economy at selected short-run lags, while inflation exhibits a positive short-run association.

Overall, the findings indicate that the relationship between government digital payments and the informal economy in Iraq differs across time horizons. The expansion of digital payments should therefore be viewed as one component of a broader economic-formalization strategy rather than as an independent policy instrument that can be expected to reduce informality by itself.

Keywords: government digital payments; informal economy; ARDL; cointegration; financial inclusion; digital infrastructure; Iraq.

ГОСУДАРСТВЕННЫЕ ЦИФРОВЫЕ ПЛАТЕЖИ И РАЗМЕР НЕФОРМАЛЬНОЙ ЭКОНОМИКИ В ИРАКЕ: АНАЛИЗ ВРЕМЕННЫХ РЯДОВ МЕТОДОМ ARDL, 2010–2024 ГГ.

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Аннотация. В данном исследовании анализируется взаимосвязь между государственными цифровыми платежами и размером неформальной экономики в Ираке на основе квартальных данных временных рядов за период с первого квартала 2010 года по четвертый квартал 2024 года. В эмпирическом анализе применяется модель авторегрессии с распределёнными лагами (Autoregressive Distributed Lag, ARDL), позволяющая разграничить краткосрочную динамику и долгосрочную равновесную взаимосвязь между неформальной экономикой, государственными цифровыми платежами, наличными денежными средствами вне банковской системы, финансовой доступностью, цифровой инфраструктурой, ростом ВВП и инфляцией. Для оценки стационарности переменных используется расширенный тест Дики — Фуллера, а для проверки наличия коинтеграции применяется процедура граничного тестирования ARDL. Краткосрочная динамика и скорость корректировки отклонений от долгосрочного равновесия оцениваются с использованием соответствующей модели коррекции ошибок.

Результаты граничного теста ARDL свидетельствуют о наличии устойчивой коинтеграционной связи между рассматриваемыми переменными. Значение F-статистики составляет 5,1852 и превышает верхнюю критическую границу на уровне значимости 1%. Коэффициент коррекции ошибки является отрицательным и высоко статистически значимым (ECT = −0,4915; p < 0,001), что означает, что примерно 49,2% отклонения от долгосрочного равновесия корректируется в течение одного квартала.

В краткосрочном периоде изменения объёма государственных цифровых платежей имеют отрицательную и статистически значимую связь с изменениями размера неформальной экономики на втором и третьем квартальных лагах. Однако оценённый долгосрочный коэффициент государственных цифровых платежей является положительным и статистически значимым (β = 0,1478; p = 0,0019). Это свидетельствует о том, что ожидаемая отрицательная взаимосвязь между расширением цифровых платежей и неформальной экономической деятельностью не сохраняется в рамках оценённой долгосрочной зависимости.

Среди дополнительных объясняющих переменных рост ВВП демонстрирует отрицательный и статистически значимый долгосрочный коэффициент (β = −0,9877; p < 0,001). В то же время наличные денежные средства вне банковской системы, финансовая доступность, цифровая инфраструктура и инфляция не имеют статистически значимых долгосрочных коэффициентов. При этом финансовая доступность демонстрирует отрицательную и статистически значимую связь с неформальной экономикой на отдельных краткосрочных лагах, тогда как инфляция имеет положительную краткосрочную связь.

В целом полученные результаты показывают, что характер взаимосвязи между государственными цифровыми платежами и неформальной экономикой в Ираке различается в зависимости от временного горизонта. Поэтому расширение цифровых платежей следует рассматривать как один из элементов более широкой стратегии формализации экономики, а не как самостоятельный инструмент экономической политики, который сам по себе способен обеспечить сокращение неформального сектора.

Ключевые слова: государственные цифровые платежи; неформальная экономика; ARDL; коинтеграция; финансовая доступность; цифровая инфраструктура; Ирак.

I. General Framework of the Study

1. Introduction

Digital transformation has become an increasingly important component of economic and financial reform in Iraq. Over the past decade, the Iraqi government and the Central Bank of Iraq have introduced a series of measures aimed at expanding electronic payment systems, reducing reliance on cash, promoting financial inclusion, and improving the efficiency and transparency of financial transactions.

An important institutional step in this process was Iraqi Council of Ministers Resolution No. 313 of 2016, followed by Resolution No. 281 of 2017, which supported the transition from

cash-based salary payments for government employees toward electronic payment mechanisms and the localization of salaries within the formal banking system (Central Bank of Iraq, 2021). The salary-localization initiative involved the opening of bank accounts for government employees and the issuance of payment cards, thereby increasing their direct interaction with formal financial institutions.

These initiatives formed part of a broader effort to develop Iraq's payment infrastructure and expand the use of electronic financial services. The Central Bank of Iraq has subsequently continued to develop payment and settlement systems, financial-inclusion initiatives, electronic collection mechanisms, and regulatory frameworks governing electronic payment services.

Despite these developments, cash remains an important component of economic activity in Iraq, while financial inclusion and participation in the formal banking system continue to face institutional, infrastructural, and behavioral constraints. At the same time, the persistence of informal economic activity presents important challenges for tax administration, economic transparency, financial-sector development, and the effectiveness of public economic policy.

Previous empirical research on Iraq identifies several factors associated with the expansion of informal economic activity, including corruption, taxation, unemployment, political and security instability, and weaknesses in governance (Abdulwahid, Ibrahim, & Saeed, 2025). These findings indicate that informality is a multidimensional phenomenon that cannot be explained solely by the prevalence of cash transactions.

Greater use of formal financial services and traceable electronic transactions may nevertheless create conditions that support economic formalization. Digital transactions generate financial records, facilitate monitoring and accounting, and may encourage households and businesses to interact more extensively with regulated financial institutions. Financial inclusion may therefore represent one of the channels through which digital-payment development affects the broader formalization process.

However, the expansion of digital payment systems does not automatically imply a reduction in the informal economy. The relationship may depend on complementary factors such as access to financial services, digital infrastructure, public confidence in financial institutions, regulatory and institutional capacity, financial literacy, and the extent to which individuals and businesses continue to rely on cash after receiving funds electronically.

Against this background, the present study examines the relationship between government digital payments and the size of the informal economy in Iraq using quarterly time-series data covering the period 2010Q1–2024Q4. Particular attention is given to distinguishing short-run dynamics from the long-run equilibrium relationship among the informal economy, government digital payments, cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation.

2. Research Problem

Iraq has experienced a substantial expansion of electronic and digital payment systems while continuing to face structural challenges associated with a cash-intensive economy and persistent informal economic activity. Although government initiatives have increasingly promoted electronic payments and the integration of public-sector transactions into the formal financial system, quantitative evidence remains limited regarding the relationship between government digital payments and the size of the informal economy in Iraq.

The relationship between digital payments and informality is not necessarily straightforward. In principle, digital payments can increase transaction traceability, facilitate participation in formal financial services, reduce reliance on cash, and improve the transparency of economic transactions. However, these potential effects may be constrained by limited financial inclusion, uneven digital infrastructure, institutional weaknesses, low confidence in formal financial institutions, and the continued importance of cash in economic activity.

Moreover, the relationship may differ across time horizons. An expansion of government digital payments may be associated with changes in informal economic activity in the short run

without necessarily producing the same relationship in the long run. It is therefore necessary to distinguish between short-run dynamics and the long-run equilibrium relationship rather than assuming that digital-payment expansion has a uniform effect over time.

Accordingly, the central research problem is to determine how government digital payments are related to the size of the informal economy in Iraq in both the short and long run, while accounting for cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation.

The main research question is formulated as follows:

What is the short-run and long-run relationship between government digital payments and the size of the informal economy in Iraq during the period 2010Q1–2024Q4?

The main research question gives rise to the following sub-questions:

1. How did government digital payments and the main indicators of digital and financial development evolve in Iraq during the study period?
2. Is there a statistically significant short-run relationship between government digital payments and the size of the informal economy?
3. Does a statistically significant long-run equilibrium relationship exist among the informal economy, government digital payments, cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation?
4. What is the direction and statistical significance of the long-run relationship between government digital payments and the size of the informal economy?
5. What roles do cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation play in the short-run and long-run dynamics of the informal economy?
6. What structural and institutional factors may limit the capacity of government digital payments to support economic formalization in Iraq?

3. Research Hypotheses

Based on the research problem and theoretical framework, the following hypotheses are proposed:

H1: Government digital payments have a statistically significant negative relationship with the size of the informal economy in Iraq in the short run.

H2: A statistically significant long-run equilibrium relationship exists among the informal economy, government digital payments, cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation.

H3: Government digital payments have a statistically significant negative relationship with the size of the informal economy in the long run.

H4: Financial inclusion and digital infrastructure have statistically significant negative relationships with the size of the informal economy in Iraq.

4. Research Objectives

The study aims to achieve the following objectives:

1. To develop a theoretical and analytical framework explaining the relationship between government digital payments and the informal economy.
2. To examine the development of government digital payments and related digital and financial indicators in Iraq during the period 2010Q1–2024Q4.
3. To estimate the short-run relationship between government digital payments and the size of the informal economy.
4. To determine whether a statistically significant long-run equilibrium relationship exists among the informal economy, government digital payments, cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation using the Autoregressive Distributed Lag (ARDL) bounds-testing approach.
5. To estimate the direction and statistical significance of the long-run relationship between government digital payments and the size of the informal economy.

6. To estimate the speed at which deviations from the long-run equilibrium are corrected using the error-correction representation of the ARDL model.
7. To assess the short-run and long-run relationships of cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation with the size of the informal economy.
8. To provide evidence-based policy recommendations concerning the role of government digital payments within broader efforts to strengthen financial inclusion, improve transaction transparency, reduce dependence on cash, and support the formalization of economic activity in Iraq.

5. Research Significance

This study contributes to the empirical literature on the relationship between government digital payments and the informal economy, with particular reference to Iraq. Although previous studies have examined electronic payments, financial inclusion, economic growth, and the determinants of informal economic activity in Iraq, quantitative research directly examining the short-run and long-run relationship between government digital payments and the size of the informal economy remains limited.

The study is particularly relevant because Iraq has been undergoing a gradual transition from a predominantly cash-based payment environment toward greater use of electronic and digital payment systems. By distinguishing between short-run dynamics and the long-run equilibrium relationship, the study provides empirical evidence on whether the expansion of government digital payments is associated with changes in informal economic activity across different time horizons.

The study also contributes methodologically by incorporating government digital payments into a multivariate ARDL framework together with cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation. This approach makes it possible to examine the relationship between digital payments and informality within a broader financial and macroeconomic context rather than in isolation.

From a policy perspective, the findings may assist policymakers, the Central Bank of Iraq, and other financial and economic authorities in evaluating the role of digital-payment expansion within broader strategies for financial inclusion and economic formalization. In particular, the results may help clarify whether the expansion of government digital payments alone is associated with lower informality or whether complementary institutional, financial, infrastructural, and economic reforms are also necessary.

6. Research Scope and Limitations

6.1. Geographical Scope

The geographical scope of the study is the **Republic of Iraq**.

6.2. Time Scope

The empirical analysis covers the period from the first quarter of 2010 to the fourth quarter of 2024 (**2010Q1–2024Q4**).

6.3. Analytical Scope

The size of the informal economy (**INF**) is specified as the dependent variable in the empirical model, while government digital payments (**DIG**) constitute the principal explanatory variable of interest.

The model also incorporates several additional variables that may be associated with informal economic activity and with the broader process of financial formalization:

- cash outside the banking system (**CUR**);
- financial inclusion (**FI**);
- digital infrastructure (**DI**);
- GDP growth (**GDP**); and
- inflation (**INFL**).

The empirical analysis therefore examines the relationship between government digital payments and the informal economy within a broader financial and macroeconomic framework. Particular attention is given to distinguishing short-run dynamics from the long-run equilibrium relationship among the variables.

6.4. Research Limitations

The study is subject to several limitations that should be considered when interpreting the empirical findings.

First, the analysis relies on secondary time-series data. Consequently, the reliability of the estimates depends on the availability, consistency, measurement quality, and comparability of the underlying data across the study period.

Second, the informal economy is inherently difficult to measure because a substantial proportion of informal economic activity is not directly recorded in official administrative or statistical systems. Estimates of the size of the informal economy may therefore be affected by measurement error and by the assumptions underlying the method used to construct the informal-economy series.

Third, historical data relating to government digital payments, financial inclusion, and digital infrastructure may be less comprehensive and less comparable during the earlier years of the sample, when Iraq's digital-payment ecosystem was substantially less developed. Changes in definitions, reporting practices, institutional coverage, or data availability over time may therefore affect the consistency of these indicators.

Fourth, the ARDL framework identifies short-run dynamic associations and long-run equilibrium relationships within the specified model. The estimated coefficients should therefore be interpreted primarily as conditional statistical relationships and should not, by themselves, be interpreted as evidence of structural causality.

Fifth, the estimated model is subject to the usual limitations of time-series specification. The results may be sensitive to variable measurement, lag selection, omitted factors, structural changes, and the relatively limited number of quarterly observations available for the analysis.

Finally, the diagnostic tests indicate some limitations in the residual properties of the estimated model. In particular, residual normality is rejected, and the serial-correlation diagnostics provide mixed evidence. These issues do not automatically invalidate the estimated ARDL relationships, but they require the statistical results to be interpreted with appropriate caution.

7. Previous Empirical Studies

The literature most directly relevant to the present study can be organized into four complementary areas: electronic payments and sustainable development, financial inclusion and economic growth, the measurement and determinants of informal economic activity, and the relationship between electronic payments and financial inclusion. Together, these studies provide the theoretical, empirical, and methodological background for examining the relationship between government digital payments and the informal economy in Iraq.

7.1. Electronic Payments and Sustainable Development in Iraq

Mohaisen (2026), in *The Role of Electronic Payment Systems in Supporting the Sustainable Development Path in Iraq*, examined the adoption of electronic payment systems in Iraq and assessed their potential contribution to selected dimensions of sustainable development.

The study analyzed Iraq's financial infrastructure, regulatory environment, and socioeconomic barriers to the wider adoption of electronic payments. It identified several important constraints, including weak infrastructure, low institutional trust, socioeconomic inequalities, and a persistent preference for cash transactions.

At the same time, the study identified several potential development channels through which electronic payments may contribute to lower transaction costs, poverty reduction, broader financial inclusion, the formalization of economic activity, and improved governance.

The relevance of Mohaisen's study to the present research lies in its identification of both the potential benefits of electronic payments and the institutional and structural constraints that

may limit their effectiveness in Iraq. However, the study provides a broad analytical assessment of electronic payments and sustainable development rather than an econometric estimation of the relationship between government digital payments and the size of the informal economy.

7.2. Financial Inclusion and Economic Growth

Hilal (2025), in *Estimating the Impact of Financial Inclusion on Promoting Economic Growth: An Econometric Study of the Iraqi Economy for the Period 2010–2023: Quarterly Data Using the ARDL Model*, examined the relationship between financial inclusion and economic growth in Iraq.

The study used quarterly data covering the period 2010–2023 and employed the Autoregressive Distributed Lag (ARDL) methodology. Financial inclusion was represented by three principal indicators: the number of bank branches, automated teller machines (ATMs), and point-of-sale (POS) terminals.

The findings indicated a positive relationship between the selected financial-inclusion indicators and economic growth in both the short and long run.

Hilal's study is relevant to the present research for both methodological and substantive reasons. Methodologically, it demonstrates the application of an ARDL framework to quarterly Iraqi financial data. Substantively, it provides evidence that the expansion of formal financial access is associated with broader economic development. However, its dependent variable is economic growth rather than the size of the informal economy, and it does not directly examine government digital payments as the principal explanatory variable.

7.3. Measurement and Determinants of Informal Economic Activity in Iraq

Abdulwahid, Ibrahim, and Saeed (2025) examined the size and determinants of the black economy in Iraq over the period 2004–2023 using the Multiple Indicators Multiple Causes (MIMIC) model.

The study identified corruption, the tax burden, unemployment, and political instability as important factors associated with the expansion of informal or shadow economic activity. It also reported particularly high estimated levels of such activity during periods of heightened instability, including 2006–2007, 2014–2016, and 2020. Improved governance was associated with lower levels of informal activity.

This study is directly relevant to the present research because it provides empirical evidence regarding the institutional and macroeconomic determinants of informal economic activity in Iraq. It also demonstrates the importance of governance, taxation, labour-market conditions, and political stability when interpreting changes in informality.

However, its primary objective is to measure the size and determinants of the black economy using a MIMIC framework. It does not examine whether government digital payments are associated with changes in the size of the informal economy.

7.4. Electronic Payments and Financial Inclusion

Huby, Ibrahim, and Abbas (2025), in *The Role of Electronic Payment Methods in Enhancing Financial Inclusion*, examined the relationship between electronic payment methods and financial inclusion in Iraq.

The study employed a quantitative cross-sectional design based on **958 responses** collected from employees in different sectors residing in Karbala Governorate. The data were analyzed using **Partial Least Squares Structural Equation Modeling (PLS-SEM)**.

The authors identified several obstacles to the wider adoption of electronic payments in Iraq, including limited awareness of the formal banking system, weak technological infrastructure, poverty, economic instability, and political instability.

The empirical results indicated a positive and statistically significant relationship between electronic payment methods and financial inclusion. The authors concluded that wider use of electronic payments may encourage participation in the formal banking system by increasing confidence in the transparency and security of financial transactions.

This study is particularly relevant because financial inclusion represents one of the potential channels through which digital-payment development may be associated with economic formalization. Nevertheless, the study is cross-sectional and focuses on financial inclusion rather than directly estimating the relationship between government digital payments and the size of the informal economy.

8. Research Gap and Contribution of the Present Study

The reviewed literature demonstrates growing academic interest in electronic payments, financial inclusion, economic growth, and informal economic activity in Iraq. However, these areas have generally been examined separately, and the direct empirical relationship between government digital payments and the size of the informal economy remains comparatively underexplored.

Existing studies of electronic payments in Iraq have primarily focused on financial inclusion, sustainable development, banking development, and the broader process of digital financial transformation. Other studies have examined the determinants and measurement of informal economic activity, emphasizing factors such as corruption, taxation, unemployment, political instability, and governance. Although these strands of literature provide important theoretical and empirical insights, they do not directly establish how government digital payments are associated with the size of the informal economy across different time horizons.

The present study addresses this gap by examining the relationship between government digital payments and the size of the informal economy in Iraq using quarterly time-series data covering the period 2010Q1–2024Q4. The study employs the Autoregressive Distributed Lag (ARDL) framework to distinguish between short-run dynamics and the long-run equilibrium relationship and uses the corresponding error-correction model to estimate the speed of adjustment following short-run deviations from equilibrium.

The empirical framework also incorporates cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation. This multivariate specification allows the relationship between government digital payments and informality to be examined within a broader financial and macroeconomic context rather than in isolation.

The contribution of the study therefore lies in empirically testing whether the relationship between government digital payments and the informal economy in Iraq differs between the short and long run, rather than assuming in advance that digital-payment expansion necessarily reduces informal economic activity. The study further contributes by assessing whether financial inclusion, digital infrastructure, cash outside the banking system, GDP growth, and inflation are associated with the dynamics of the informal economy within the same empirical framework.

By doing so, the study provides evidence relevant to the design of digital-payment and economic-formalization policies in Iraq and helps clarify the extent to which the expansion of government digital payments should be considered as one component of a broader institutional, financial, and economic reform strategy.

II. Theoretical and Conceptual Framework

1. The Concept of the Informal Economy

1.1. Definition and Terminology

The informal economy is a broad concept encompassing economic activities undertaken by workers and economic units that are, in law or in practice, not covered or insufficiently covered by formal institutional arrangements. According to the International Labour Organization (ILO), this concept includes both economic units operating informally and workers holding informal jobs, including informal employment that may occur within formally established enterprises (International Labour Organization, 2015).

Importantly, the informal economy should not automatically be equated with illegal or criminal activity. ILO Recommendation No. 204 explicitly distinguishes informal economic activity from illicit activities prohibited by law. Informality may therefore involve otherwise legal

production, employment, trade, or service provision that is not fully covered by registration, taxation, labour regulation, social protection, or other formal institutional arrangements.

Related terms such as *shadow economy*, *hidden economy*, *underground economy*, and *black economy* are also used in the literature. These concepts overlap but are not always identical. The terms *shadow* or *hidden economy* are commonly associated with economic activity deliberately concealed from public authorities, whereas the broader concept of the informal economy may also encompass workers and economic units that remain outside formal arrangements because of structural, institutional, or economic constraints.

For the purposes of the present study, the term **informal economy** is used as the principal conceptual term. Its empirical measurement should be understood in accordance with the specific operational definition and data series used for the variable INF, which are described in the empirical methodology section.

The informal economy has important implications for economic policy. Extensive informality may reduce the effective tax base, limit the coverage of labour and social-protection systems, restrict access to formal financial services, complicate the measurement of economic activity, and weaken the effectiveness of fiscal and monetary policy.

1.2. Characteristics of the Informal Economy

The characteristics of informal economic activity vary across countries, sectors, enterprises, and forms of employment. Nevertheless, several features are commonly associated with informality.

1. **Limited or absent formal registration.** Informal enterprises or workers may operate without complete registration with tax, labour, social-security, commercial, or other relevant authorities.
2. **Incomplete regulatory coverage.** Economic activities may not be fully covered in law or in practice by labour regulation, taxation, licensing requirements, accounting standards, or other formal rules.
3. **Limited access to formal financial services.** Informal enterprises may rely more heavily on personal savings, family networks, informal credit, and cash transactions than on formal banking and credit markets.
4. **Limited labour and social protection.** Workers in informal employment may lack formal employment contracts, pension coverage, paid leave, health or social insurance, and other employment-related protections.
5. **Greater reliance on cash.** Informal economic activity may rely relatively heavily on cash because cash transactions generally generate fewer directly accessible transaction records than regulated electronic payments.
6. **Small-scale and flexible organization.** Many informal economic units are relatively small and may respond rapidly to changes in employment opportunities, household income needs, and economic conditions.

These characteristics also help explain why informal economic activity is difficult to observe directly and why estimates of its magnitude differ substantially depending on the concepts, data, and estimation methodology employed.

1.3. Factors Contributing to the Informal Economy in Iraq

The persistence of informal economic activity in Iraq can be associated with a combination of institutional, macroeconomic, financial, and social factors.

a. Institutional and Regulatory Factors

Institutional weaknesses, administrative complexity, weaknesses in enforcement, and limitations in the regulatory and tax environment may increase incentives or pressures for firms and individuals to operate outside formal arrangements.

Abdulwahid, Ibrahim, and Saeed (2025), using a MIMIC-based framework for Iraq over the period 2004–2023, identify taxation and governance-related factors among the determinants

associated with informal economic activity. Their findings suggest that informality in Iraq should not be interpreted solely as a tax-avoidance phenomenon but as part of a broader institutional and economic environment.

b. Economic and Structural Factors

Unemployment, economic instability, corruption, and periods of political and security instability may also contribute to informal economic activity.

Abdulwahid, Ibrahim, and Saeed (2025) identify corruption, the tax burden, unemployment, and political instability as important factors associated with the size of the black economy in Iraq. Their estimates also indicate higher levels of informal activity during periods of pronounced political and economic instability.

These findings suggest that informality may partly reflect structural economic conditions and institutional uncertainty rather than solely deliberate avoidance of taxation or regulation.

c. Social, Financial, and Behavioral Factors

Financial exclusion, limited financial literacy, weak technological infrastructure, and low confidence in formal financial institutions may indirectly reinforce informality by reducing the ability or willingness of individuals and businesses to participate in formal financial systems.

Huby, Ibrahim, and Abbas (2025), using survey data from 958 respondents in Karbala Governorate, identify limited awareness of formal banking services, weak technological infrastructure, poverty, and economic and political instability among the barriers affecting the adoption of electronic payments.

Their empirical results also indicate a positive and statistically significant relationship between electronic payment methods and financial inclusion. This relationship is relevant to the present study because participation in formal financial services may represent one of the channels through which digital-payment development can support broader economic formalization.

1.4. Methods for Measuring the Informal Economy

Because informal economic activity is not fully observable in conventional administrative statistics, several direct and indirect approaches have been developed to estimate its size.

a. Currency Demand Approach

The currency demand approach is based on the assumption that concealed or unrecorded economic activity tends to make relatively greater use of cash because cash transactions are less readily traceable than transactions conducted through formal financial channels.

The approach generally estimates currency demand as a function of conventional monetary and economic determinants together with variables associated with incentives to operate informally. A counterfactual level of currency demand is then used to estimate the excess demand for cash potentially associated with unrecorded economic activity.

The approach has important limitations. Not all informal transactions are conducted in cash, and not all cash transactions are informal. Estimates are also sensitive to the specification of the currency-demand equation and to the assumptions used to convert excess cash holdings into estimates of informal production.

b. MIMIC Model

The Multiple Indicators Multiple Causes (MIMIC) model treats the informal economy as an unobserved latent variable influenced by several observable causes and reflected in several observable indicators.

Its principal advantage is that it allows multiple potential determinants and manifestations of informality to be incorporated simultaneously into a structural model.

Abdulwahid, Ibrahim, and Saeed (2025) apply a MIMIC-based approach to Iraq for the period 2004–2023 and identify corruption, taxation, unemployment, and political instability as important determinants associated with informal economic activity.

However, MIMIC estimates are sensitive to model specification, the choice of causal and indicator variables, and the calibration procedure used to convert a latent index into an economically interpretable measure, such as a percentage of GDP. The method should therefore

be treated as one of several available approaches rather than as a universally superior measurement technique.

c. Tax-Gap Approach

The tax-gap approach estimates the difference between the amount of tax theoretically due under existing tax legislation and the amount actually collected.

A tax gap may reflect tax evasion, underreporting, weaknesses in tax administration, non-compliance, or economic activity occurring outside formal tax systems. However, it should not be treated as a complete measure of the informal economy because the difference between potential and actual tax revenue may arise from several factors unrelated to informal production.

d. National Accounts and Statistical Approaches

Informal economic activity may also be estimated using labour-force surveys, household surveys, enterprise surveys, economic censuses, national-accounts adjustments, and other statistical techniques intended to identify production not fully captured in administrative data.

Quiros-Romero, Alexander, and Ribarsky (2021), in the IMF framework for measuring the informal economy, emphasize that the broader statistical concept may encompass production by informal-sector units, household production of goods for own final use, production by paid domestic workers, and production generated by informal employment within formal enterprises.
This broader statistical perspective illustrates why the informal economy is multidimensional and why no single indicator or estimation method captures all forms of informality.

2. The Concept of Government Digital Payments

2.1. Definition

Government digital payments refer to financial transactions in which government entities make or receive payments through electronic or digital channels instead of relying exclusively on cash-based mechanisms.

Such transactions may include government-to-person (**G2P**) payments, including public-sector salaries, pensions, subsidies, and social transfers; government-to-business (**G2B**) payments, including payments relating to public procurement; and person- or business-to-government payments, including taxes, fees, fines, and other public charges(World Bank, 2021).
Government digital payments may be conducted through bank accounts, payment cards, electronic wallets, electronic transfer systems, mobile-payment platforms, and other regulated digital-payment channels.

Government digital payments constitute one component of the wider electronic-payment ecosystem. Their potential relevance to economic formalization arises from their capacity to generate transaction records, increase interaction with formal financial institutions, and potentially reduce dependence on cash. However, these mechanisms do not imply that digital payments necessarily reduce informal economic activity.

2.2. Government Digital Payment Infrastructure and Instruments in Iraq

Iraq's digital-payment environment comprises several interconnected payment, clearing, and settlement systems operated or supervised by the Central Bank of Iraq.

a. Real-Time Gross Settlement System (RTGS)

The Real-Time Gross Settlement (**RTGS**) system is a core component of Iraq's national payment infrastructure. It facilitates transfers among banks, the Central Bank of Iraq, its branches, and other institutional participants and provides final settlement for transactions generated through other payment systems.

The RTGS system began operating in Iraq in 2006 and was subsequently upgraded. According to the Central Bank of Iraq, the system was updated to operate on a 24/7 basis in June 2024.

b. Check Automated Clearing House (C-ACH)

The **Check Automated Clearing House (C-ACH)** enables participating banks and their branches to exchange payment orders electronically.

The system processes electronic payment instructions and coded electronic cheques and transmits the resulting net settlement positions to the RTGS system for final settlement. It has also been adapted to support electronic payment orders relating to the localization of government salaries and the automation of government financial transfers.

c. Point-of-Sale (POS) Terminals

Point-of-sale (**POS**) terminals enable payments for goods, services, fees, and other transactions to be processed electronically using payment cards and related payment instruments.

Official Central Bank of Iraq data show that the number of POS terminals increased from **10,718 in 2022 to 23,066 in 2023**. The rapid expansion continued during 2024. In August 2024, the Governor of the Central Bank of Iraq reported that the number of POS terminals had exceeded **50,000**, compared with approximately **11,000** at the beginning of 2023.

The substantial difference between the 2023 and 2024 figures reflects the rapid expansion of electronic-payment infrastructure following government and Central Bank initiatives to promote the wider use of POS terminals.

d. Electronic Wallets, Payment Cards, and Government Electronic Payments

Electronic wallets and payment cards are important retail-payment instruments that allow individuals and businesses to conduct transactions without relying exclusively on physical cash.

According to the Central Bank of Iraq's *Annual Economic Report 2023*, the number of electronic wallets increased from **2,970,390 in 2022 to 4,980,427 in 2023**. The total number of bank cards reached approximately **19.75 million in 2023**, compared with approximately **16.20 million in 2022**.

Government-related electronic transactions also expanded rapidly during 2024. In August 2024, the Governor of the Central Bank of Iraq reported that government electronic payments reached approximately **IQD 912 billion in July 2024**, compared with IQD 287 million in July 2023. During the same month, the value processed through the national payment switch exceeded **IQD 2 trillion**, compared with approximately IQD 800 billion in July 2023.

These developments demonstrate a substantial expansion of Iraq's electronic-payment infrastructure and transaction volumes. Nevertheless, the expansion of payment infrastructure should not be interpreted as evidence that the economy has become predominantly cashless.

2.3. Indicators of Digital Transformation and Electronic Payments in Iraq

Official Central Bank of Iraq data demonstrate substantial growth in several indicators of financial and digital-payment infrastructure.

In 2023, the number of bank accounts increased to approximately **13.29 million**, compared with approximately 8.80 million in 2022. The number of ATMs increased from **2,223 to 4,021**, while POS terminals increased from **10,718 to 23,066**. Electronic wallets increased from approximately **2.97 million to 4.98 million**, and the number of bank cards increased from approximately **16.20 million to 19.75 million**.

The expansion continued during 2024. By August 2024, the Central Bank of Iraq reported more than **50,000 POS terminals**, while the value of government electronic payments reached approximately **IQD 912 billion in July 2024**.

These indicators demonstrate the rapid development of Iraq's electronic-payment ecosystem. However, growth in the number of accounts, cards, wallets, ATMs, and POS terminals does not necessarily imply equivalent growth in their active use or an automatic reduction in cash dependence. The distinction between access to digital financial infrastructure and its sustained use is therefore important when assessing the relationship between digital payments, financial inclusion, and economic formalization.

3. Channels Through Which Government Digital Payments May Affect the Informal Economy

Government digital payments may be associated with informal economic activity through several interrelated channels. These channels should be understood as potential theoretical mechanisms rather than as effects that necessarily arise automatically from the introduction or

expansion of digital-payment systems. Their effectiveness depends on the institutional, financial, technological, and behavioral environment in which digital payments operate.

3.1. Transparency and Transaction Traceability

Digital payment systems generate electronic records of financial transactions. Compared with cash transactions, these records can improve the traceability of financial flows and facilitate accounting, auditing, compliance monitoring, and financial oversight.

When government salaries, transfers, fees, taxes, and other public-sector transactions are processed through regulated electronic channels, transaction records may improve financial accountability and reduce the scope for payments to remain entirely outside formal recording systems.

Greater transaction traceability may also support economic formalization by increasing interaction between individuals, businesses, government institutions, and regulated financial intermediaries. However, transaction traceability alone does not guarantee formalization. Its effectiveness depends on the capacity of public institutions to use financial information appropriately, the quality of regulatory enforcement, and the integration of payment systems with accounting, taxation, registration, and other administrative frameworks.

3.2. Reduction of Reliance on Cash Outside the Banking System

One potential channel through which electronic payments may influence informal economic activity is by reducing dependence on cash held and circulated outside the formal banking system.

Ibrahim, Al-Ramli, and Asmaeel (2025) report an inverse relationship between the expansion of electronic payment systems and cash circulation outside banks in Iraq. Their study argues that broader adoption of electronic payments may support financial inclusion and strengthen the effectiveness of monetary policy by encouraging a greater proportion of financial transactions to pass through formal financial channels.

Akawee (2026), using monthly Iraqi data for 2020–2024 and an ARDL framework, also reports a positive and statistically significant relationship between digital financial services and financial inclusion in both the short and long run. The study further suggests that the development of digital financial services can support a gradual transition away from exclusive reliance on cash and can generate financial information relevant to access to formal credit.

Nevertheless, a reduction in cash dependence should not be assumed to follow automatically from the expansion of government digital payments. Individuals may receive salaries or transfers electronically and subsequently withdraw the funds in cash. Consequently, the relationship between digital payments and cash outside the banking system remains an empirical question and depends on whether digital funds continue to circulate electronically after the initial payment.

3.3. Tax Administration and the Formalization of Economic Activity

Digital transactions may support tax administration by generating financial records that can potentially be integrated with accounting, invoicing, business registration, and tax-reporting systems.

Greater use of traceable transactions may make some forms of economic underreporting more difficult and may improve the ability of tax authorities to identify taxable transactions and economic activity. Digital payments may therefore contribute to the effective broadening of the tax base when they form part of a wider system of formal registration and financial reporting.

However, the introduction of digital payment mechanisms does not automatically increase tax compliance or reduce tax evasion. Their effectiveness depends on the integration of payment systems with tax administration, electronic invoicing, business registration, regulatory enforcement, data governance, and the administrative capacity of public institutions.

This mechanism is particularly relevant in Iraq because the economy remains highly dependent on cash and financial inclusion remains limited relative to more digitally developed

economies. International assessments continue to characterize Iraq as a highly cash-dependent economy with comparatively low use of digital payments.

Accordingly, the transition from cash-based to more traceable digital transactions may create opportunities to strengthen tax administration and economic formalization, but such effects require complementary institutional and regulatory reforms.

3.4. Financial Inclusion Channel

Government digital payments may also support economic formalization by increasing access to and use of formal financial services.

Receiving public-sector salaries, pensions, social transfers, or other government payments through regulated bank accounts or electronic payment instruments can bring individuals into direct contact with formal financial institutions. Once connected to the formal financial system, users may potentially gain access to additional services such as savings, transfers, payments, and credit.

Akawee (2026), using monthly Iraqi data for 2020–2024, reports a positive and statistically significant relationship between digital financial services and financial inclusion in both the short and long run.

Similarly, Hilal (2025), using quarterly data covering 2010–2023, reports positive relationships between financial-inclusion indicators—including bank branches, ATMs, and POS terminals—and economic growth in Iraq.

Huby, Ibrahim, and Abbas (2025) also find a positive and statistically significant relationship between electronic payment methods and financial inclusion in their cross-sectional study of 958 respondents in Karbala Governorate.

Taken together, these studies suggest that electronic-payment development and financial inclusion may reinforce one another. However, greater financial inclusion should not automatically be interpreted as a reduction in informal economic activity. Individuals and businesses may gain access to formal financial services while continuing to conduct a substantial share of their economic transactions informally. The relationship between financial inclusion and informality must therefore be evaluated empirically.

3.5. Financial Transparency, Corruption, Tax Evasion, and Unrecorded Transactions

A further potential channel concerns the capacity of electronic payments to increase financial transparency and reduce the scope for transactions to remain entirely undocumented. Cash transactions generally generate less readily accessible transaction-level documentation than payments conducted through regulated electronic channels. Digital government transactions may therefore improve auditability and strengthen the capacity of authorized public institutions to monitor financial flows.

Research on Iraq identifies corruption and governance weaknesses among the factors associated with informal economic activity. Abdulwahid, Ibrahim, and Saeed (2025), using a MIMIC-based analysis, identify corruption as one of the determinants associated with the size of the black economy in Iraq.

Electronic payment systems may therefore support financial transparency when combined with effective auditing, tax administration, regulatory supervision, anti-money-laundering controls, and appropriate institutional safeguards.

However, digitalization should not be assumed to eliminate corruption, tax evasion, or unrecorded economic activity. Digital transactions can improve traceability, but their effectiveness depends on institutional quality, enforcement capacity, cybersecurity, data governance, legal safeguards, and the integrity of the institutions responsible for using financial information.

3.6. Limitations and Obstacles to the Effectiveness of Digital Payments

Several structural, institutional, technological, and behavioral factors may limit the capacity of government digital payments to contribute to economic formalization in Iraq.

1. Limited Banking and Payment Infrastructure

Iraq has historically had relatively limited access to formal banking and payment infrastructure. Although the number of ATMs, POS terminals, electronic wallets, payment cards, and bank accounts has increased substantially in recent years, access to financial services remains uneven across geographical areas and population groups. Infrastructure availability is also only one dimension of effective access. Reliable telecommunications, electricity, payment-system interoperability, merchant acceptance, service availability, and the ability of users to access their funds are all important for the sustained use of electronic payments.

Continued development of payment and banking infrastructure is therefore necessary to broaden the practical use of digital financial services, particularly outside the largest urban and commercial centers.

2. Limited Public Trust in Financial Institutions

Public confidence is an important determinant of participation in formal banking and digital-payment systems. Iraqi studies identify limited confidence in formal financial institutions and electronic-payment systems as one of the obstacles to wider adoption.

Ibrahim, Al-Ramli, and Asmaeel (2025) identify low public trust and weak banking infrastructure among the constraints affecting the expansion of electronic payments in Iraq. Mohaisen (2026) similarly identifies low institutional trust among the structural barriers to wider electronic-payment adoption.

Concerns relating to service quality, the availability of cash, transaction reliability, cybersecurity, institutional stability, consumer protection, and the security of personal financial information may encourage individuals to continue holding and using cash even when digital-payment options are available.

Consequently, the expansion of digital-payment infrastructure needs to be accompanied by improvements in service quality, consumer protection, financial security, institutional credibility, and mechanisms for resolving payment-related disputes.

3. Digital and Financial Literacy

Limited financial and digital literacy may restrict the adoption and effective use of electronic payment systems, particularly among individuals and businesses with limited previous interaction with formal financial institutions.

Huby, Ibrahim, and Abbas (2025) identify limited awareness of formal banking services and weak technological infrastructure among the barriers affecting the adoption of electronic payments in Iraq.

Accordingly, policies aimed at expanding financial inclusion require more than technological infrastructure alone. Consumer education, accessible financial services, clear information on the use of digital-payment instruments, and effective consumer-protection mechanisms are also important for encouraging sustained participation in the formal financial system.

4. Regulatory and Institutional Constraints

Effective digital-payment systems require a coherent legal and regulatory framework governing electronic transactions, payment-service providers, consumer protection, cybersecurity, data protection, anti-money-laundering requirements, and interoperability among financial institutions and payment systems.

Weak institutional coordination, regulatory fragmentation, or incomplete implementation of relevant rules may reduce the effectiveness of digital-payment reforms. Consequently, technological expansion needs to be accompanied by clear regulation, effective supervision, institutional coordination, and appropriate mechanisms for protecting users and financial data.

5. Persistence of Cash-Based Economic Behavior

The continued preference for cash represents an important challenge to the wider use of digital payments in Iraq. Although electronic-payment infrastructure has expanded substantially,

the availability of digital-payment instruments does not necessarily imply that individuals and businesses will use them continuously for subsequent transactions.

For example, salaries or transfers received electronically may be withdrawn shortly after receipt and subsequently used in cash. In such cases, the initial government payment is digital, but the broader transaction chain remains largely cash-based.

Consequently, the potential contribution of government digital payments to economic formalization depends not only on digitizing the initial payment but also on the development of a broader financial ecosystem in which individuals and businesses can conveniently make, receive, save, and transfer funds electronically.

III. Empirical Framework

Data Sources and Measurement

The empirical analysis uses quarterly data for 2010Q1–2024Q4 compiled from published statistical materials of the Central Bank of Iraq and relevant national and international statistical sources. The informal economy variable (INF) is expressed as an index representing changes in the estimated size of informal economic activity, while government digital payments (DIG) are expressed as an index representing the development of government electronic-payment activity. For consistency across the study period, the series were standardized to a common index scale, with 2010 = 100. Where only annual observations were available, quarterly values were obtained through linear interpolation.

The principal data sources were the statistical publications and payment-system reports of the Central Bank of Iraq, supplemented, where necessary, by published national and international statistical data and estimates for the corresponding indicators.

1. Unit Root Testing and Stationarity

Before estimating the Autoregressive Distributed Lag (ARDL) model, the time-series properties of the variables were examined using the Augmented Dickey–Fuller (ADF) unit root test (Dickey & Fuller, 1979).

The null hypothesis of the ADF test is that a time series contains a unit root and is therefore non-stationary. Rejection of the null hypothesis indicates stationarity under the deterministic specification used in the test.

Establishing the order of integration is particularly important in the present study because the ARDL bounds-testing approach can accommodate variables that are stationary at level, I(0), variables that become stationary after first differencing, I(1), or a combination of the two. However, the conventional ARDL bounds-testing procedure is not valid when any variable is integrated of order two, I(2), or higher.

Accordingly, each variable was first tested at level. Variables that failed to reject the unit-root null hypothesis at level were subsequently tested after first differencing.

Table 1. Augmented Dickey–Fuller (ADF) Unit Root Test Results

Variable	Level t-statistic	Level p-value	First-difference t-statistic	First-difference p-value	Order of integration
INF	3.297684	0.9999	−9.423764	0.0000	I(1)
GDP	−5.867262	0.0000	—	—	I(0)
INFL	−5.670707	0.0000	—	—	I(0)
DIG	3.131223	0.9999	−7.153253	0.0000	I(1)
DI	3.543425	0.9999	−12.495602	0.0000	I(1)
CUR	−1.046579	0.7306	−9.802613	0.0000	I(1)
FI	3.297684	0.9999	−11.823151	0.0000	I(1)

Source: Author's calculations based on EViews output.

The ADF results indicate a mixed order of integration among the study variables.

GDP growth (GDP) and inflation (INFL) are stationary at level, I(0), since the unit-root null hypothesis is rejected at conventional significance levels.

By contrast, the informal economy (INF), government digital payments (DIG), digital infrastructure (DI), cash outside the banking system (CUR), and financial inclusion (FI) are non-stationary at level but become stationary after first differencing. These variables are therefore classified as I(1).

The results consequently indicate that the empirical model contains a combination of I(0) and I(1) variables and that none of the reported series is integrated of order two, I(2). This integration structure is consistent with the requirements of the ARDL bounds-testing approach.

The use of the ARDL framework is therefore appropriate with respect to the reported orders of integration. Nevertheless, the ADF results should be interpreted together with the deterministic specification and lag-selection procedure used in each unit-root regression, since these choices can affect the outcome of unit-root testing.

2. Estimation of the ARDL Model

Following the unit-root analysis, the Autoregressive Distributed Lag (ARDL) model was estimated with the size of the informal economy (INF) specified as the dependent variable. The Akaike Information Criterion (AIC) was used as the lag-selection criterion.

The selected specification was:

ARDL(2,0,4,4,0,3,2)

Given the ordering of variables in the estimated model, this specification includes two lags of INF, no lag of CUR, four lags of DIG, four lags of FI, no lag of DI, three lags of GDP, and two lags of INFL.

Table 2. ARDL Model Estimation Results for INF

Variable	Coefficient	Standard Error	t-Statistic	p-value
INF(−1)	0.216463	0.131156	1.650421	0.1081
INF(−2)	0.291994	0.116953	2.496684	0.0175
CUR	−0.327089	0.242392	−1.349426	0.1861
DIG	−0.068169	0.074933	−0.909735	0.3694
DIG(−1)	0.032931	0.095199	0.345919	0.7315
DIG(−2)	−0.087031	0.092821	−0.937623	0.3551
DIG(−3)	0.066770	0.090286	0.739539	0.4647
DIG(−4)	0.128134	0.071024	1.804102	0.0801
FI	0.186774	0.533921	0.349816	0.7286
FI(−1)	−0.859727	0.501392	−1.714681	0.0955
FI(−2)	−1.221806	0.533084	−2.291955	0.0282
FI(−3)	0.483350	0.513579	0.941140	0.3533
FI(−4)	1.277493	0.523078	2.442262	0.0199
DI	−0.206059	0.308540	−0.667854	0.5087
GDP	−0.034891	0.052685	−0.662259	0.5123
GDP(−1)	−0.094167	0.047786	−1.970607	0.0570
GDP(−2)	−0.184323	0.050253	−3.667889	0.0008
GDP(−3)	−0.172104	0.061343	−2.805577	0.0082
INFL	0.283494	0.119455	2.373222	0.0234
INFL(−1)	0.126971	0.119821	1.059678	0.2968
INFL(−2)	−0.331767	0.123616	−2.683860	0.0112

C	68.218072	23.840951	2.861382	0.0072

Source: Author's calculations based on EViews output.

Model Fit Statistics

Statistic	**Value**
R-squared	0.974530
Adjusted R-squared	0.958798
F-statistic	61.947316
Prob(F-statistic)	0.000000
Durbin–Watson statistic	2.182144

The estimated ARDL model exhibits a high degree of in-sample fit, with an R-squared of 0.9745 and an adjusted R-squared of 0.9588. However, because the specification contains multiple lagged regressors, including lagged values of the dependent variable, the high coefficient of determination should not by itself be interpreted as evidence of model validity, causal explanatory power, or absence of specification problems.

The overall F-statistic is 61.9473 with a probability value below 0.001, indicating that the explanatory variables are jointly statistically significant within the estimated ARDL specification.

The coefficients reported in Table 2 represent the unrestricted dynamic ARDL specification. They should not be interpreted individually as the final short-run or long-run effects. Long-run coefficients are derived from the normalized long-run representation of the ARDL model, whereas the short-run dynamics are evaluated using the corresponding error-correction model.

The lagged dependent variable INF(−2) has a positive and statistically significant coefficient at the 5% level (β = 0.2920, p = 0.0175), providing evidence of persistence in the dynamics of the informal economy. INF(−1) is also positive but is not statistically significant at the 5% level.

For government digital payments (DIG), neither the contemporaneous coefficient nor the first three lagged coefficients is statistically significant at the 5% level. DIG(−4) is positive and marginally significant at the 10% level (β = 0.1281, p = 0.0801). These unrestricted ARDL coefficients should not, however, be used to characterize the overall short-run relationship between digital payments and the informal economy, which is examined more appropriately through the error-correction representation.

The coefficient on cash outside the banking system (CUR) is negative but statistically insignificant (β = −0.3271, p = 0.1861). The estimated unrestricted ARDL equation therefore does not provide statistically significant evidence of a contemporaneous association between CUR and INF.

Financial inclusion (FI) exhibits a mixed lag structure. FI(−2) is negative and statistically significant at the 5% level (β = −1.2218, p = 0.0282), whereas FI(−4) is positive and statistically significant (β = 1.2775, p = 0.0199). FI(−1) is negative and marginally significant at the 10% level (p = 0.0955). The alternating signs across lags reinforce the need to evaluate the short-run dynamics through the error-correction model rather than interpreting individual lag coefficients in isolation.

Digital infrastructure (DI) has a negative but statistically insignificant coefficient (β = −0.2061, p = 0.5087). Accordingly, Table 2 does not provide evidence of a statistically significant contemporaneous association between DI and the informal economy within the estimated specification.

GDP growth exhibits statistically significant negative coefficients at the second and third lags. GDP(−2) has a coefficient of −0.1843 (p = 0.0008), while GDP(−3) has a coefficient of −0.1721 (p = 0.0082). GDP(−1) is also negative and marginally significant at the 10% level (p = 0.0570). These lagged coefficients indicate a dynamic relationship between GDP growth and the

informal economy, but the final short-run and long-run interpretations should be based on the ECM and long-run representations.

Inflation also exhibits coefficients with different signs across lags. The contemporaneous coefficient is positive and statistically significant (β = 0.2835, p = 0.0234), while INFL(−2) is negative and statistically significant (β = −0.3318, p = 0.0112). INFL(−1) is not statistically significant. This pattern indicates that the unrestricted lag structure does not support a simple uniform interpretation of the relationship between inflation and informality.

Overall, Table 2 provides the dynamic foundation for the subsequent bounds test, long-run estimation, and error-correction analysis. The individual coefficients reported in the unrestricted ARDL model should therefore be interpreted primarily as components of the dynamic specification rather than as stand-alone estimates of the study's principal short-run or long-run relationships.

3. ARDL Bounds Test for Cointegration

Following the estimation of the ARDL model, the bounds-testing procedure developed by Pesaran, Shin, and Smith (2001) was applied to determine whether a long-run levels relationship exists among the variables.

The null and alternative hypotheses are:

H_0: No long-run levels relationship exists among the variables.

H_1: A long-run levels relationship exists among the variables.

Table 3. ARDL Bounds Test for Cointegration

Test Statistic	Value	k
F-statistic	5.185189	6

Critical Value Bounds

Significance Level	I(0) Bound	I(1) Bound
10%	1.99	2.94
5%	2.27	3.28
1%	2.88	3.99

Source: Author's calculations based on EViews output.

The calculated F-statistic is **5.185189**, which exceeds the upper-bound critical value, I(1), at the 10%, 5%, and 1% significance levels. In particular, the test statistic exceeds the 1% upper-bound critical value of **3.99**.

Accordingly, the null hypothesis of no long-run levels relationship is rejected. The bounds test therefore provides strong evidence of cointegration among the informal economy (INF), government digital payments (DIG), cash outside the banking system (CUR), financial inclusion (FI), digital infrastructure (DI), GDP growth (GDP), and inflation (INFL).

This finding supports **Hypothesis H2**, which proposes the existence of a statistically significant long-run equilibrium relationship among the variables included in the model.

The bounds-test result establishes the existence of a long-run relationship among the variables but does not, by itself, establish structural causality or the direction of influence between individual variables.

4. Estimation of the Long-Run Relationship

Given the evidence of cointegration, the normalized long-run coefficients were derived from the estimated ARDL model.

Table 4. Estimated Long-Run Coefficients

Variable	Coefficient	Standard Error	t-Statistic	p-value
CUR	−0.665434	0.475817	−1.398507	0.1683
DIG	0.147770	0.044950	3.287422	0.0019

FI	−0.272439	0.935088	−0.291351	0.7720
DI	−0.419210	0.631643	−0.663681	0.5100
GDP	−0.987676	0.189320	−5.216963	0.0000
INFL	0.160104	0.359629	0.445191	0.6581
C	138.783584	41.656421	3.331625	0.0016

Source: Author's calculations based on EViews output.

The estimated long-run equilibrium relationship can be expressed as:

$$\mathbf{INF_t = 138.7836 - 0.6654CUR_t + 0.1478DIG_t - 0.2724FI_t - 0.4192DI_t - 0.9877GDP_t + 0.1601INFL_t}$$

The coefficients should be interpreted according to the measurement units of the respective variables. Unless the variables are expressed in logarithmic form, they should not be interpreted as elasticities.

Government Digital Payments

The long-run coefficient of government digital payments (DIG) is positive and statistically significant:

β = 0.1478, p = 0.0019.

Holding the other variables constant, higher values of DIG are therefore associated with higher values of the informal-economy measure in the estimated long-run relationship. The positive coefficient is contrary to the hypothesized negative long-run relationship between government digital payments and informal economic activity. Consequently, **Hypothesis H3 is not supported**.

This result should not be interpreted as evidence that government digital payments cause the informal economy to expand. It indicates a positive conditional long-run association within the estimated model. The mechanism underlying this association cannot be established from the ARDL coefficient alone.

The result is particularly important because the relationship differs across time horizons. As shown subsequently in the error-correction model, changes in government digital payments exhibit negative and statistically significant coefficients at selected short-run lags, whereas their estimated long-run coefficient is positive and statistically significant.

Cash Outside the Banking System

The estimated long-run coefficient of cash outside the banking system is:

β = −0.6654, p = 0.1683.

The coefficient is negative but not statistically significant at conventional significance levels. Therefore, the estimated model does not provide sufficient evidence of a statistically significant long-run relationship between CUR and the informal economy after controlling for the other variables.

The sign of the coefficient should not be given a strong substantive interpretation in the absence of statistical significance.

Financial Inclusion

The estimated long-run coefficient of financial inclusion is:

β = −0.2724, p = 0.7720.

Although the coefficient is negative, it is not statistically significant. The model therefore does not provide evidence of a statistically significant long-run relationship between FI and the size of the informal economy.

This result does not imply that financial inclusion is economically irrelevant. It indicates only that a statistically significant direct long-run association cannot be established within the present specification and sample.

Digital Infrastructure

The estimated long-run coefficient of digital infrastructure is:

β = −0.4192, p = 0.5100.

The coefficient is negative but statistically insignificant. Accordingly, the estimated model does not provide sufficient evidence of a statistically significant direct long-run relationship between DI and the informal economy.

The absence of statistical significance should not be interpreted as proof that digital infrastructure has no role in economic formalization. Its influence may operate through other channels that are not separately identified by the estimated long-run coefficient.

GDP Growth

GDP growth exhibits a negative and statistically significant long-run coefficient:

$\beta = -0.9877, p < 0.001$.

Higher GDP growth is therefore associated with lower values of the informal-economy measure in the estimated long-run relationship, holding the other variables constant.

The coefficient should be interpreted as a conditional long-run association rather than as definitive evidence that GDP growth structurally causes reductions in informality.

Inflation

The estimated long-run coefficient of inflation is:

$\beta = 0.1601, p = 0.6581$.

The coefficient is positive but statistically insignificant. Consequently, the model does not provide sufficient evidence of a statistically significant long-run relationship between inflation and the size of the informal economy during the study period.

Overall Interpretation of the Long-Run Results

The estimated long-run coefficients reveal a heterogeneous pattern across the explanatory variables.

Government digital payments exhibit a **positive and statistically significant** long-run association with the informal economy, whereas GDP growth exhibits a **negative and statistically significant** long-run association. Cash outside the banking system, financial inclusion, digital infrastructure, and inflation do not exhibit statistically significant long-run coefficients.

These findings indicate that the relationship between digital-payment expansion and informality in Iraq is more complex than a simple expectation that increasing digitalization will automatically reduce informal economic activity.

5. Error-Correction Model and Short-Run Dynamics

Given the evidence of a long-run equilibrium relationship, the corresponding error-correction representation was estimated to examine short-run dynamics and the speed at which deviations from long-run equilibrium are corrected.

Table 5. Error-Correction Model Results

Variable	Coefficient	Standard Error	t-Statistic	p-value
ECT(−1)	−0.491543	0.069499	−7.072611	0.0000
ΔINF(−1)	−0.291994	0.097773	−2.986447	0.0047
ΔDIG	−0.068169	0.060230	−1.131821	0.2643
ΔDIG(−1)	−0.107873	0.060227	−1.791104	0.0807
ΔDIG(−2)	−0.194904	0.059305	−3.286486	0.0021
ΔDIG(−3)	−0.128134	0.059614	−2.149388	0.0376
ΔFI	0.186774	0.335332	0.556983	0.5806
ΔFI(−1)	−0.539037	0.303982	−1.773251	0.0836
ΔFI(−2)	−1.760843	0.323197	−5.448204	0.0000
ΔFI(−3)	−1.277493	0.371740	−3.436520	0.0014
ΔGDP	−0.034891	0.044062	−0.791878	0.4330
ΔGDP(−1)	0.356426	0.064095	5.560887	0.0000

ΔGDP(−2)	0.172104	0.046999	3.661882	0.0007
ΔINFL	0.283494	0.086876	3.263205	0.0022
ΔINFL(−1)	0.331767	0.091513	3.625366	0.0008

Source: Author's calculations based on EViews output.

Model Fit Statistics

Statistic	Value
R-squared	0.713977
Adjusted R-squared	0.616311
F-statistic	7.310374
Prob(F-statistic)	0.000000
Durbin–Watson statistic	2.182144

The error-correction term, ECT(−1), is negative and highly statistically significant:

ECT(−1) = −0.491543, p < 0.001.

The negative sign is consistent with convergence toward the estimated long-run equilibrium. Its magnitude indicates that approximately **49.15% of the previous quarter's disequilibrium is corrected within one quarter**. Thus, following a disturbance, approximately half of the deviation from the long-run equilibrium is eliminated during the subsequent quarter.

The statistically significant error-correction term provides evidence of an adjustment mechanism consistent with the cointegrating relationship identified by the ARDL bounds test. The bounds test remains the primary test used to establish the existence of the long-run relationship.

Government Digital Payments: Short-Run Dynamics

The contemporaneous change in government digital payments is negative but statistically insignificant:

ΔDIG = −0.0682, p = 0.2643.

The first lag is also negative but is statistically significant only at the 10% level:

ΔDIG(−1) = −0.1079, p = 0.0807.

By contrast, the second and third lags are negative and statistically significant:

ΔDIG(−2) = −0.1949, p = 0.0021

and

ΔDIG(−3) = −0.1281, p = 0.0376.

These results indicate that increases in government digital payments are associated with subsequent reductions in the informal-economy measure at selected short-run lags. The evidence therefore supports **Hypothesis H1 only partially**, because the expected negative relationship is statistically significant at selected lags rather than uniformly across the short-run specification.

Financial Inclusion: Short-Run Dynamics

The contemporaneous coefficient of ΔFI is statistically insignificant, while ΔFI(−1) is negative and marginally significant at the 10% level.

The second and third lagged changes in financial inclusion are negative and statistically significant:

ΔFI(−2) = −1.7608, p < 0.001

and

ΔFI(−3) = −1.2775, p = 0.0014.

Thus, increases in financial inclusion at selected previous quarters are associated with reductions in the informal-economy measure in the short run. However, financial inclusion does not exhibit a statistically significant long-run coefficient.

GDP Growth: Short-Run Dynamics

The contemporaneous change in GDP growth is statistically insignificant:

ΔGDP = −0.0349, p = 0.4330.

However, the first and second lagged changes are positive and statistically significant:
ΔGDP(−1) = 0.3564, p < 0.001
and
ΔGDP(−2) = 0.1721, p = 0.0007.
The positive short-run coefficients contrast with the negative and statistically significant long-run GDP coefficient. The relationship between GDP growth and informality therefore differs between the short and long run. The estimated model alone does not identify the structural mechanism responsible for this difference.

Inflation: Short-Run Dynamics

Changes in inflation exhibit positive and statistically significant short-run coefficients:
ΔINFL = 0.2835, p = 0.0022
and
ΔINFL(−1) = 0.3318, p = 0.0008.
Higher inflation is therefore associated with increases in the informal-economy measure in the contemporaneous quarter and at the first quarterly lag within the estimated short-run model. However, inflation does not exhibit a statistically significant long-run coefficient, indicating that its estimated relationship with informality is concentrated in the short-run dynamics of the model.

Cash Outside the Banking System and Digital Infrastructure

No differenced CUR or DI terms appear in the error-correction representation because the selected ARDL specification assigns zero distributed lags to both variables.
Their absence from the differenced short-run component should therefore not be interpreted as an omission from the model. Their estimated roles are represented through the long-run levels relationship.

Overall Interpretation of the Error-Correction Model

The ECM provides evidence of a statistically significant adjustment toward long-run equilibrium and reveals substantial differences between short-run and long-run relationships. Government digital payments and financial inclusion exhibit negative associations with the informal economy at selected short-run lags, while inflation exhibits positive short-run associations. GDP growth exhibits positive coefficients at selected short-run lags but a negative long-run coefficient.

These findings reinforce the conclusion that the determinants of informal economic activity operate differently across time horizons and that individual ARDL coefficients should not be interpreted as uniform causal effects.

6. Diagnostic Tests

Following the estimation of the ARDL model and its error-correction representation, a series of diagnostic tests was conducted to assess the adequacy of the estimated specification. The diagnostic analysis focuses on residual serial correlation, heteroskedasticity, residual normality, and parameter stability.

6.1. Serial Correlation Test

Residual serial correlation was examined using the **Breusch–Godfrey Serial Correlation LM Test** with two lag orders.

The null hypothesis is:

H_0: There is no serial correlation in the residuals up to lag 2.

The alternative hypothesis is:

H_1: Serial correlation is present in the residuals.

Table 6. Breusch–Godfrey Serial Correlation LM Test

Test Statistic	Value	Probability
F-statistic	2.232135	0.1237
Obs*R-squared	6.856003	0.0325

Source: Author's calculations based on EViews output.

The two reported test statistics provide different conclusions at the 5% significance level.

The F-statistic has a probability value of **0.1237**, which exceeds 0.05. On the basis of this statistic, the null hypothesis of no residual serial correlation is not rejected.

However, the Breusch–Godfrey LM statistic, reported by EViews as **Obs*R-squared**, has a probability value of **0.0325**, which is below 0.05. On the basis of the LM statistic, the null hypothesis of no serial correlation up to lag 2 is rejected at the 5% significance level.

The results should therefore be described as providing **mixed evidence concerning residual serial correlation**. It would not be appropriate to conclude that the model is entirely free from autocorrelation.

In particular, because the Obs*R-squared statistic is the Breusch–Godfrey LM statistic, its statistically significant result indicates that possible residual serial correlation should be recognized as a diagnostic limitation of the estimated model. This issue should be taken into account when interpreting coefficient significance and other statistical inference.

6.2. Heteroskedasticity Test

Residual heteroskedasticity was examined using the **Breusch–Pagan–Godfrey test**.

The null hypothesis is:

H_0: The residual variance is homoskedastic.

The alternative hypothesis is:

H_1: The residual variance is heteroskedastic.

Table 7. Breusch–Pagan–Godfrey Heteroskedasticity Test

Test Statistic	Value	Probability
F-statistic	0.620732	0.8740
Obs*R-squared	15.519823	0.7960
Scaled explained SS	12.305781	0.9310

Source: Author's calculations based on EViews output.

All reported probability values are substantially greater than the 5% significance level:

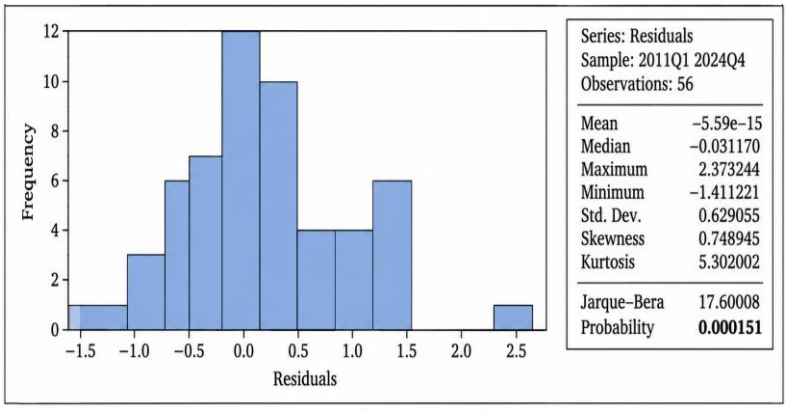
- Prob. F = **0.8740**;
- Prob. Chi-square for Obs*R-squared = **0.7960**;
- Prob. Chi-square for the scaled explained sum of squares = **0.9310**.

Accordingly, the null hypothesis of homoskedasticity is not rejected. The Breusch–Pagan–Godfrey test therefore provides **no evidence of heteroskedasticity** in the residuals of the estimated model.

This result indicates that heteroskedasticity does not appear to constitute a significant diagnostic problem within the estimated specification.

6.3. Residual Normality Test

The distribution of the model residuals was examined using the **Jarque–Bera normality test**.



Source: Author's calculations based on EViews output.

Figure 1. Distribution of Model Residuals and Jarque–Bera Normality Test

Source: Author's calculations based on EViews output.

The Jarque–Bera statistic is **17.6001**, with a probability value of **0.000151**. Since the p-value is below the 1% significance level, the null hypothesis that the residuals are normally distributed is rejected.

The descriptive statistics also indicate departures from normality. The residuals exhibit positive skewness (**0.7489**) and kurtosis of **5.3020**, which exceeds the normal-distribution benchmark of 3. These results indicate that the residual distribution is positively skewed and has heavier tails than a normal distribution.

Accordingly, the Jarque–Bera test provides clear evidence that the residuals are **not normally distributed**.

Residual non-normality does not, by itself, invalidate the estimated ARDL coefficients or the evidence of a long-run equilibrium relationship. However, it may affect the reliability of finite-sample statistical inference, particularly given the relatively limited effective estimation sample of **56 observations**.

The normality result should therefore be acknowledged as a diagnostic limitation of the model. The estimated coefficients and associated significance tests should consequently be interpreted with appropriate caution.

6.4. Structural Stability Test

The parameter stability of the estimated ARDL model was examined using the **CUSUM test**. The CUSUM procedure evaluates the cumulative sum of recursive residuals relative to the corresponding 5% critical boundaries.

Under the null hypothesis, the estimated parameters remain stable over the evaluation period. If the CUSUM statistic remains within the 5% critical boundaries, the null hypothesis of parameter stability is not rejected. Movement outside the critical boundaries would indicate evidence of parameter instability.

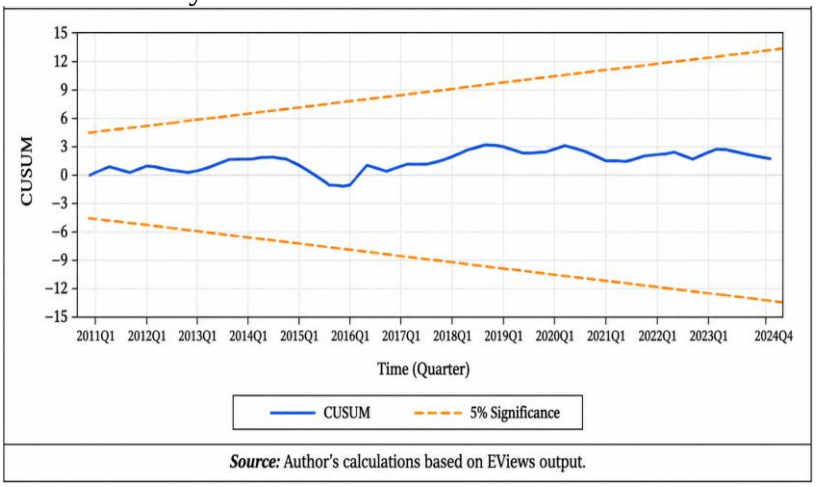


Figure 2. CUSUM Test for Parameter Stability

Source: Author's calculations based on EViews output.

As shown in Figure 2, the CUSUM statistic remains within the 5% critical boundaries throughout the evaluation period. Therefore, the null hypothesis of parameter stability is not rejected.

The CUSUM test thus provides no evidence of substantial parameter instability over the evaluation period. This result supports the stability of the estimated ARDL coefficients over time.

However, parameter stability should not be interpreted as evidence that the model satisfies all diagnostic assumptions. The CUSUM finding should be considered together with the other diagnostic results. In particular, the residuals are not normally distributed, and the Breusch–Godfrey test provides mixed evidence concerning residual serial correlation, whereas the Breusch–Pagan–Godfrey test provides no evidence of heteroskedasticity.

The empirical results reveal that the relationship between government digital payments and the informal economy differs substantially between the short and long run. The research hypotheses are therefore evaluated separately using the ARDL bounds test, the estimated long-run coefficients, and the short-run error-correction model.

IV. Summary of Results and Hypothesis Testing

The empirical results demonstrate that the relationship between government digital payments and the informal economy in Iraq differs substantially between the short and long run. The research hypotheses are therefore evaluated on the basis of the ARDL bounds test, the estimated long-run coefficients, and the short-run error-correction model.

Table 8. Summary of Hypothesis Testing Results

Hypothesis	Description	Empirical Evidence	Decision
H1	Government digital payments have a statistically significant negative relationship with the size of the informal economy in Iraq in the short run.	In the ECM, $\Delta DIG(-2) = -0.1949$ ($p = 0.0021$) and $\Delta DIG(-3) = -0.1281$ ($p = 0.0376$). The contemporaneous coefficient is insignificant, while $\Delta DIG(-1)$ is significant only at the 10% level.	**Partially supported**
H2	A statistically significant long-run equilibrium relationship exists among the informal economy, government digital payments, cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation.	The ARDL bounds-test statistic is $F = 5.1852$, exceeding the I(1) upper critical bound of 3.99 at the 1% level. The error-correction term is also negative and highly significant: $ECT(-1) = -0.4915$ ($p < 0.001$).	**Supported**
H3	Government digital payments have a statistically significant negative relationship with the size of the informal economy in the long run.	The estimated long-run coefficient of DIG is positive and statistically significant: $\beta = 0.1478$ ($p = 0.0019$). The expected negative long-run relationship is therefore not observed.	**Not supported**
H4	Financial inclusion and digital infrastructure have statistically significant negative relationships with the size of the informal economy in Iraq.	FI exhibits statistically significant negative coefficients at selected short-run lags, but its long-run coefficient is insignificant ($\beta = -0.2724$, $p = 0.7720$). DI has a negative but statistically insignificant long-run coefficient ($\beta = -0.4192$, $p = 0.5100$), and the selected ARDL specification contains no differenced DI term in the ECM.	**Partially supported**

Source: Author's calculations based on the empirical results.

Overall, the strongest evidence concerns the existence of a long-run equilibrium relationship among the variables. The expected negative relationship between government digital payments and the informal economy is observed at selected short-run lags but is not supported in the long run. Financial inclusion also exhibits negative short-run associations at selected lags, whereas the evidence for a statistically significant relationship between digital infrastructure and the informal economy is insufficient.

V. Conclusions

This study examined the relationship between government digital payments and the size of the informal economy in Iraq using quarterly data covering the period 2010Q1–2024Q4 and an ARDL-based empirical framework.

First, the ARDL bounds test provides strong evidence of cointegration among the variables. The F-statistic of **5.1852** exceeds the upper critical bound even at the 1% significance level. The results therefore support the existence of a long-run equilibrium relationship among the informal economy, government digital payments, cash outside the banking system, financial inclusion, digital infrastructure, GDP growth, and inflation. This finding supports **H2**, but it should not be interpreted as evidence of structural causality between individual variables.

Second, government digital payments exhibit a negative and statistically significant relationship with the informal economy at selected short-run lags. Specifically, $\Delta DIG(-2)$ and $\Delta DIG(-3)$ are negative and statistically significant, whereas the contemporaneous coefficient is insignificant. The evidence therefore provides **partial support for H1**, indicating a delayed rather than uniform short-run negative association.

Third, the estimated long-run relationship differs markedly from the short-run results. The long-run coefficient of government digital payments is **positive and statistically significant** ($\beta = 0.1478$, $p = 0.0019$). Consequently, the hypothesized negative long-run relationship is not supported, and H3 is not supported.

The positive long-run coefficient should not be interpreted as evidence that government digital payments cause the informal economy to expand. Rather, it indicates that, conditional on the other variables included in the model, higher values of DIG are associated with higher values of the informal-economy measure in the estimated long-run relationship. The structural mechanism underlying this result cannot be identified from the ARDL coefficient alone.

Fourth, GDP growth exhibits a statistically significant **negative long-run association** with the informal economy ($\beta = -0.9877$, $p < 0.001$). In contrast, the ECM identifies positive coefficients for selected lagged changes in GDP growth. The relationship between GDP growth and informality therefore differs between short- and long-run horizons.

Fifth, financial inclusion exhibits statistically significant negative associations with the informal economy at selected short-run lags, particularly $\Delta FI(-2)$ and $\Delta FI(-3)$. However, its estimated long-run coefficient is not statistically significant. Digital infrastructure also has a negative but statistically insignificant long-run coefficient. Accordingly, **H4 is only partially supported**.

Sixth, the error-correction term is negative and highly statistically significant:

$ECT(-1) = -0.4915$, $p < 0.001$.

This indicates that approximately **49.2% of the previous quarter's deviation from long-run equilibrium is corrected within one quarter**, providing evidence of a substantial adjustment mechanism toward the estimated equilibrium relationship.

Seventh, the diagnostic tests produce mixed results. The Breusch–Pagan–Godfrey test provides no evidence of heteroskedasticity, and the CUSUM test provides no evidence of substantial parameter instability. However, the Jarque–Bera test rejects residual normality, while the Breusch–Godfrey test provides mixed evidence concerning residual serial correlation. These diagnostic limitations should be considered when interpreting coefficient significance and finite-sample statistical inference.

Overall, the empirical findings show that the relationship between government digital payments and the informal economy in Iraq is neither uniform nor automatically negative. Digital-payment expansion is associated with lower informality at selected short-run lags, but the estimated long-run coefficient is positive. Government digital payments should therefore be viewed as one component of a broader process of economic and financial formalization rather than as an independent policy instrument that can be expected to reduce informal economic activity by itself.

VI. Recommendations

The empirical findings, together with the theoretical and institutional context examined in the study, suggest the following policy priorities.

1. **Develop the digital-payment ecosystem with emphasis on effective use rather than infrastructure expansion alone.** Continued improvement in telecommunications networks, POS terminals, ATMs, electronic wallets, interoperable payment systems, and related infrastructure is important. However, policy evaluation should focus not only on the number of digital-payment instruments available but also on their regular and sustained use.
2. **Promote continued electronic use of government payments after the initial transfer.** The formalization potential of electronically paid salaries, pensions, and transfers may remain limited if recipients immediately convert the funds into cash. Policies should therefore encourage an environment in which households and businesses can conveniently retain, transfer, save, and spend funds electronically.
3. **Strengthen financial inclusion.** Access to formal financial accounts and digital financial services should be expanded, particularly for individuals and small businesses with limited interaction with the banking system. Simplified procedures, affordable services, and improved accessibility may support broader participation in formal finance.
4. **Strengthen public confidence in banks and payment systems.** Improvements in service quality, cybersecurity, data protection, consumer protection, transaction reliability, dispute-resolution mechanisms, and access to funds are important for encouraging sustained use of formal financial services.
5. **Integrate digital payments with broader economic-formalization policies.** Digital-payment development should be coordinated with business registration, tax administration, electronic invoicing, accounting systems, and other administrative reforms. Transaction traceability is more likely to contribute to formalization when it forms part of a coherent institutional framework.
6. **Improve digital and financial literacy.** Public education initiatives should improve knowledge of electronic payments, account security, consumer rights, digital financial services, and the practical advantages and risks associated with electronic transactions.
7. **Strengthen the regulatory and institutional framework.** Continued development of rules governing electronic payments, payment-service providers, cybersecurity, data protection, consumer protection, anti-money-laundering requirements, and interoperability should accompany the technological expansion of Iraq's payment system.
8. **Improve monitoring and evaluation of digital-payment policies.** Government institutions and the Central Bank of Iraq should distinguish between access to digital-payment instruments and their actual use. Evaluation should consider transaction volumes, transaction values, cash withdrawals, account activity, merchant acceptance, and other indicators of sustained digital-payment adoption.
9. **Improve the quality and consistency of statistical data.** More detailed and consistently defined quarterly data on government digital payments, cash holdings, electronic transactions, financial inclusion, digital infrastructure, informal employment, and informal economic activity would improve the reliability and reproducibility of future empirical research.
10. **Conduct further econometric robustness analysis.** Future research should examine alternative specifications, structural breaks, asymmetric relationships, alternative measures of informality and digital payments, and robustness procedures that account for possible residual serial correlation and non-normality.
11. **Treat digitalization as part of a broader economic-development strategy.** Since GDP growth exhibits a statistically significant negative long-run association with the informal economy, policies aimed at reducing informality should not focus exclusively on digital payments. Employment creation, private-sector development, institutional quality,

governance, financial-sector development, and wider macroeconomic stability should form part of an integrated formalization strategy.

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